No. 21. – March 3d – A. M.

Remarks on Animal Respiration. – –

Submitted to the Medical Faculty of the University of

Pennsylvania.

February – 1812. – –

"Nullius addictus jurare in verba magistri."
"Quo me cunque rapit "veritas,"
"deferor hospes."
Horace Lib. 1. Epis. 1. – –

The
essen
mate
the s
tems,
the e
by t
inte
return
resu
guar
unten
in gu
in oth
mal
shall
to exa
Whyo
Fun
defin
for m
med.
of the
is ai
that
and
red co
in the
federa

On Animal Respiration.

The action of the heart and lungs is essential to animal existence. The intimate connection that subsists between the sanguiferous and pulmonary systems, is curious and important, and the changes that are effected in the blood by this connection deserve the most minute and careful attention. The blood returned to the heart by the pulmonary veins differs in colour and chemical qualities from that in the pulmonary arteries; and it shall be my object to inquire how this change is effected, or in other words what is the use of animal respiration.— In this inquiry I shall not deem it important minutely to examine the opinions of the earlier Physiologists— as their theories of this function were necessarily vague, indefinite and oftentimes visionary— for no correct hypothesis could be formed without a perfect knowledge of the compound nature of atmospheric air. It is proper however to remark that Lower, Boyle, Vertesyen, Borelli and Mayow asserted that the florid red colour of the blood was produced in the lungs, that some change was effected in the air taken into those organs

and
pure
illus
Phio
of la
made
over
name
But
vagu
abu
a ne
ing
of h
a Th
bea
it m
the o
that
hon
med
was
ged
a flo
the a
that
with
gas
of ex
the s
the
hart
origin

and that some portion of it was con-
sumed in Respiration. Dr Black (a name
illustrious in the annals of Chemical
Philosophy) demonstrated the existence
of Carbonic acid gas in expired air and
made rapid strides towards those dis-
coveries that have immortalized the
names of Priestly and Lavoisier.
But every theory of Respiration was
vague and conjectural until the brilli-
ant discovery of oxygen gas. This gave
a new direction to the labours of inquir-
ing physiologists and upon the basis
of pneumatic chemistry they formed
a theory of Respiration at once new,
beautiful and ingenious. By this
it was stated that oxygen gas was
the only essential agent in Respiration
that a portion combined with the car-
bon discharged from the blood and for-
med carbonic acid gas - another portion
was absorbed into the blood and chan-
ged its colour from a dark black to
a florid red, which distinguishes
the arterial from the venous and
that the residual quantity together
with the nitrogen and carbonic acid
gas - was thrown out in every act
of expiration. - Such is the theory of
the supporters of the oxygenation of
the blood - differing however in many
particulars from that which was
originally given to the world. Lavoisier

and
that
the
and
which
carri
taine
by a
form
its it
that
the
to sta
he ad
or rel
which
exist
obser
habit
insen
is no
and
Dr Pr
of re
addit
and
to ex
air.
no re
by the
mean
esis d
and t

and Crawford, for example, contended that the blood in circulating through the body acquired a quantity of carbon and hydrogen, forming a binary compound which is now known by the name of carburetted hydrogen. This they maintained was discharged in respiration by uniting with the oxygen of the air forming Carbonic acid gas and water. As it is now conceded by Physiologists that no hydrogen is discharged from the bloodvessels - it is unnecessary to state the arguments that might be advanced against such an hypothesis or relate the experiments of Bichat which prove that no such gas does or can exist in the bloodvessels - it may be observed, however, that the substancy halitus discharged is nothing but the insensible perspiration and of course is not formed by an union of oxygen and hydrogen in the lungs. —

Dr Priestly contended that the colour of venous blood was owing to the addition of his favourite Phlogiston and that the use of Respiration was to expose the blood to dephlogisticated air. I must confess that to my mind no very definite idea is conveyed by this term Phlogiston - but if he meant simply hydrogen - his hypothesis differs not from that of Lavoisier and Crawford and is liable to the

same
prin
tor, m
adm
Prom
does
unn
the
more
Mosq
phas
ab le
gener
no
ever
that,
unit
supp
unco
Thes
of
brate
conte
air co
this
that
those
repu
and a
from
hapen,
this p
was a

same objections; if however an unknown principle was supposed to be phlogiston, we certainly are not compelled to admit its existence, until it can be proved — and the supposition that it does exist is wholly gratuitous and unnecessary if we can account for the various phenomena of respiration more philosophically without it. — Modified and corrected by different physiologists, this theory appeared at length, as I have stated it and was generally admitted by the world, for no opinion in Physiology perhaps was ever for a time more popular than that, which maintained that oxygen united with the blood. Some of its supporters began to inquire how this union could be effected and upon this subject considerable difference of opinion existed. Haller, the celebrated physiologist, long since contended, that no absorption of air could take place in the lungs, this he inferred from the mucus that is constantly poured out upon those organs and from the known repulsion that exists between water and air, which prevents the latter from passing through moistened paper, linen or leather. Notwithstanding this opinion the doctrine of absorption was admitted by many, though it

was s
and t
gen lo
Ohan
of colo
veins, f
mark
the ein
of the
lot the
arterie
of the
mento
any aff
Blood
having
an aff
that c
unite
nary
verhar
thardy
Relaxe
evider
lung a
nary c
inter
coats
This
lego n
in vio
con
origin
in the

was strenuously opposed by Drs Goodwyn and Girtanner. If we admit that oxygen is absorbed in the lungs, still one shall be unable to account for the change of colour in the blood in the pulmonary veins, for (as it has been ingeniously remarked by the first of these writers) the air must follow the usual course of the absorbent vessels by which it would be carried not into the pulmonary arteries or veins, but into the right side of the heart. — — Various experiments were made to ascertain whether any affinity existed between venous blood and oxygen gas and Girtanner having satisfied himself that such an affinity did exist, he was confident that it was in this way that oxygen united with the blood in the pulmonary arteries. But Mr Ellis justly remarks, that actual contact is essentially necessary for the exertion of chemical affinity — now it must be evident that between the air in the lungs and the blood in the pulmonary arteries there must ever be interposed the membranes of the lungs and the coats of the bloodvessels and of course this affinity cannot be exerted, unless we may suppose it can operate in violation of one of its own laws.

Convinced that these two methods originally stated to shew the manner in which oxygen unites with the

Blood
some
were
were
which
Blood
excite
sure
the
the
with
into
the
brain
physi
gy
write
or
Blood
mean
mann
But
adva
a con
is
rev.
and
gener
of Re
rose
hum

blood were wholly unsatisfactory, some physiologists asserted that there were inorganic pores in the lungs which were constantly open, and through which air might pass freely into the blood vessels. But admitting the existence of such pores (which we surely are not bound to do until they have been demonstrated) still the oxygen would not come in contact with the blood, but would only pass into the cellular membrane between the coats of the arteries and the membranes of the lungs, producing emphysematous swelling.* — — —

It has of late been conceded by some writers, that the three ways in which oxygen is said to unite with the blood are unsatisfactory and by no means capable of explaining the manner in which this union is effected. But they have not been diffident in advancing a new theory or rather a conjecture — which in my opinion is equally untenable with the rest. They maintain that there are a set of absorbent vessels sui generis, that open upon the membranes of the air cells — for the express purpose of conveying oxygen into the pulmonary veins. Without remarking

* Vide Ellison Air.

That
pla
the s
and
cal f
It no
with
two
supp
gen
gt
man
feeta
forme
by w
blood
ygen
a f
usua
ters of
with
has
as con
trina.
affor
That
the G
ing
to ob
cond
with
have
that

that it is unphilosophical to multiply causes, it may be observed that the supposition is wholly gratuitous and in direct opposition to anatomical fact. —

It may not be improper to examine with some degree of attention, one or two experiments that have been supposed to demonstrate, that oxygen does unite with the blood, though they by no means point out the manner in which this union is effected. The first of these was performed by Dr Priestly. it was that by which he ascertained that venous blood exposed in a wet bladder to oxygen gas or atmospheric air, assumed a florid red. This experiment has usually been related by the supporters of the oxygenation of the blood with some degree of triumph and has always been considered by them as conclusive in favour of their doctrine. But it does not in reality afford it the least support; we know that in the living animal body the Gall bladder is capable of containing the bile, but how common is it to observe after death all the viscera in the neighbourhood tinged with this thick fluid, that must have escaped through the coats that formerly contained it. The

Ma do
living
deaf
entra
carbo
ation
that c
recall
was
in a f
syste
tion
them
this c
mitin
der. th
the S
many
in fa
gen. a
rem
been
ing
the a
ing
of in
mad
conc
our
dare

bladder though impervious in the living body, may no doubt after death, afford a free passage to the entrance of oxygen or the exit of carbon, in consequence of the relaxation that takes place in the fibres that compose it. -- We should also recollect that some considerable time was necessary to effect this change in a few ounces of blood, while in the living system the whole mass of circulating fluid even supposing it to be twenty five pounds undergoes this change in six minutes.* Admitting that these remarks do not destroy or invalidate the effect of the experiment and that it still may be urged with equal force in favour of the theory of the oxygenation of the blood, I would remark that Physiology has been in no way more seriously injured than by reasoning from dead to living matter, by attempting to explain processes that go on in the body by experiments made out of it and by theorizing concerning the living system without remembering that it is endowed with vitality. The table

* See a calculation of Fordyce in his work on fevers

carbonic acid gas is inwardly formed and the volume of air in the receiver is diminished — hence the seed absorbs oxygen. Mr Ellis whose experiments upon this subject are the latest and by far the most decisive, has shewn that growing vegetables require oxygen and that carbonic acid gas is formed sufficient to account for all the oxygen consumed. It is only from such view of the subject

Fo
a bri
the w
was
dec
it wi
from
hence
took
admit
Dr
may
collec
powe
a way
perim
them
circu
body
pumel
different
other,
precis
were
tubes
in this
chine.
obliged
etc. a
a regu
from of

Fontana infused into a blood vessel of a living animal, a small portion of the venom of the viper, the blood was immediately coagulated and death ensued — but when he mixed it with this fluid as it was flowing from a vessel, no change could be perceived in it and no coagulation took place. We cannot be too cautious in admitting experiments similar to that of Dr Priestly, however imposing they may appear, for we should always recollect that the living system has a power of modifying their results in such a way as can only be known by experimenting upon living animals themselves. Not very long since the circulation of the fluids through the body was explained upon principles purely mechanical; the angles that the different arteries made with each other were calculated with wonderful precision, the different vessels themselves were considered to be merely rigid tubes and the animal body was nothing in this estimate but an hydraulic machine. But physiologists have been obliged to confess that the laws of Geometry and Mathematics are wholly inadequate to the explanation of the functions of living animals and that the principle

of wit
operat
of a in
prin
be in

be re
condi
the a
ascen
in a
contac
not eq
: areas
: atmo
: where
as it
esch
furthe
the T
versit
anima
tions
become
from
tonic
quanti
we mu
extent
body
nourish
tain the

vitality, though imperfectly understood
perates so powerfully, that all explanations
animal processes, founded upon the
principles of mechanical philosophy must
be inadequate, trifling and visionary.—

Another experiment has been
brought forward with considerable
confidence and which has at first view
the appearance of being conclusive. It was
ascertained by placing living animals
in a given quantity of air, that the oxygen
contained in the carbonic acid gas was
not equal to the oxygen lost and hence it
was concluded that a portion of the
atmospheric oxygen that had been in-
spired had united with the blood,
as it could not be detected in the gas
expired. To this experiment it has
justly been objected (and I believe by
the Professor of Chemistry in this Uni-
versity) that the Respiration of the
animal after the few first inspira-
tions and expirations must have
become laborious and unnatural,
from the increased quantity of car-
bonic acid gas and the diminished
quantity of oxygen gas in the vessel.—
We might as well endeavour to
establish the laws of the healthy
body by studying the various Phe-
nomena of disease as attempt to ascer-
tain the changes that take place in the air in

Prev
effect
ou a

ted
oeng
that
supp
are
satisf
rema
is to
in the
the
some
that
the
phase
ties
conne
genat
the g
Resh
and th
the ca
gas ex
that
mer o
conten
tion i
the o
carbon
the

healthy respiration by observing the effects of this process when it is laborious and unnatural. — — — — —

Hitherto I have only attempted to show that it is impossible for oxygen to unite with the blood and that the experiments that have been supposed to demonstrate such an union are wholly inconclusive and unsatisfactory; a more difficult task remains to be accomplished and that is to account for the change of colour in the blood while passing through the lungs and attempt to explain some of the phenomena of respiration that have been inexplicable upon the former theory. Some modern physiologists perceiving the absurdities if not impossibilities that were connected with the theory of the oxygenation of the blood and observing the quantity of carbon discharged in respiration, have maintained that all the oxygen lost ~~to~~ combines with the carbon to form the carbonic acid gas expired. It will be perceived that this theory differs from the former chiefly in this— that the one contends that the use of respiration is to oxygenize the blood while the other maintains that it is to decarbonize it. Should it be said that the heat of the body was not sufficient

to produce an union between the carbon of the blood and the oxygen of the air, forming carbonic acid gas; — we might reply by saying, that this objection can not be made by a supporter of the theory of the oxygenation of the blood, since it would have equal weight against that theory as the present — for it was in this way that they accounted for the presence of carbonic acid gas in expired air. But this is not the only answer; the ingenuity of the Professor of Chemistry has supplied us with one perfectly conclusive and irresistible. We may suppose that the carbon when discharged from the blood is in a forming state just ready to unite with the oxygen — in a state analogous to that of hydrogen when it unites with nitrogen to form ammonia and of course does not require a high temperature to produce the union. Some persons, influenced probably by the objection that I have just now attempted to obviate, have maintained that no carbon was discharged from the blood — for they asserted that carbonic acid gas itself was thrown out from the bloodvessels; — to shew the fallacy of this it is only necessary to remark that if it were true, the oxygen contained in the carbonic acid gas expired would not be precisely the same in quan

ity as that lost in Respiration, as it is
in all the experiments of Allen & Pepys
to be mentioned hereafter. - But this
remark is wholly inapplicable to an ex-
periment performed by Dr Hartshorn of
this city; with a view to ascertain from
what source the carbonic acid gas
was derived he opened "a pregnant
bitch under water and transferred
one of the foetuses into a jar of pure
azotic gas. The young animal breathed
regularly at long intervals, for the space
of ten minutes. At then appeared to be
dead and was taken out." Upon exam-
ining the air by lime water, carbonic
acid gas was discovered in it. Dr Hartshorn
does not inform us, whether the water
employed was distilled water or not
and as he is careful to tell us that no
oxygen was united with the azote, if
he had been equally cautious concern-
ing the water he used, we should no
doubt have heard of it, we have a
right therefore to conclude that he employed
common water, containing probably
some carbonic acid gas, some atmospheric
air and some oxygen gas - if this were
the case the experiment is completely
invalidated, as the greatest accuracy
is necessary in experiments of this nature
or they can be of no value. But in addition
to this I would observe that Mr Murray
remarks, that "the supposition" viz that
which maintained the existence of carbonic
acid gas in venous blood) "seems even to be

produc
strobe
fluid

It
speak
I sugg
of the
ving
ment
gives
This o
of ven
previ
conta
blood
urana
rose a
of coa
dition
stone
blood
to ven
muc
than
asso
mer
mest
mitt
that
mine
said
for the
the

precluded by the fact, that when blood has absorbed carbonic acid, it is not rendered florid by subsequent exposure to oxygen.

It may be recollected that in speaking of Dr Priestley's experiment I suggested that the change of the colour of the blood in that case might be owing to the escape of carbon — an experiment performed by Dr Girtanner gives I think some probability to this opinion. He exposed a quantity of venous blood to oxygen gas, having previously placed in the jar that contained the gas a thermometer. The blood soon assumed a florid red colour and the mercury in the thermometer rose a few degrees. Now if this change of colour was owing only to the addition of oxygen, the temperature should have been reduced — for the blood was changed from arterial to venous and the arterial has a much greater capacity for caloric than venous and of course would absorb it from the surrounding bodies. This however was not the fact we must therefore resort to some other method of explaining it. Shall we suppose that this change was produced merely by the escape of carbon, we shall find no difficulty in accounting for the change of temperature, from the known difference of capacity for

ca vie
w. It
facuty
of rote
1.0300 c
but w
differ
mean
the ca
of car
gai, w
to. The
ve ge
that o
to 1.04
That a
ficien
has be
Gunta
viz. t
Hood
correc
degre
gn. an

—

when
is di
ne se
vi. A
ated
that

caloric which oxygen has, when compared with carbonic acid gas. Placing the capacity of water for caloric at 1.0000 that of arterial blood is said to be equal to 1.0300 and that of venous blood to .8928, but we must be convinced that this difference of capacity would by no means be sufficient to employ all the caloric liberated by the conversion of carbon and oxygen into carbonic acid gas, whence recollect that according to the same scale the capacity of oxygen gas is equal to 4.7490, while that of carbonic acid gas is only equal to 1.0454 and of course we may suppose that a quantity of caloric remained sufficient to raise the temperature as has been stated.— The conclusion that Girtanner drew was very different viz. that oxygen unites with the blood— that this is so far from being correct, that it is not in the least degree warranted by the premises I have endeavoured to show. — —

— — It may perhaps be asked whence is the carbon derived that is discharged from the pulmonary vessels in respiration? and how is it that so much should be accumulated in venous blood? To this I reply that I by no means suppose that

ca bon
iscu
Forme
That
prince
lation
the th
ca bo
our
pec
know
but
mott
where
an
That
and s
officer
and
Forte
He u
He
again
Amma

F
implem
That
zation
in o
my
natu
unpl
Cong
Nation

carbon is imparted to the blood while circulating through the body, as was formerly maintained, nor do I suppose that the blood acquires any noxious principle in the whole course of circulation; but it must be evident, that the blood contains a large portion of carbon, both from the nature of our food and the analyses that have been made of that fluid, and it is known, that this principle enters but in small proportions in animal matter. now in the extreme vessels where the animal fluids and solids are formed - those parts of the blood that enter into their formation are separated from the carbon and other constituent of that fluid and in this consists the conversion of arterial into venous blood and the use of Respiration is to discharge the carbon and render the blood again fit for the purposes of the animal oconomy. —

From this view of the subject, imperfect as it is, it must be evident that the doctrine of the decarbonization of the blood, so far from involving any absurdity accords with the general simplicity of nature in all her operations and is amply sufficient to explain the changes produced in the blood, while passing through the lungs.

"But
gone
tha, a
ced-
epleo
wiv
to Lan
they
We H
retrac
the Lo
and
ment
"That
"consc
"ry
"of can
"a. La
"one
accup
La d
great
That
of the
Vinn
deter
of the
Lo ed
unite

But fortunately for us we can adduce some stronger proof of its correctness than any that has as yet been advanced - we can in support of this doctrine appeal to direct experiment - upon which our opponents seem so much to have relied and which we trust they will not be disposed to question. With a view to ascertain the relation between the consumption of oxygen and the formation of carbonic acid gas. Allen and Pepys instituted a set of experiments which satisfactorily prove "that there is no excess of oxygen "consumed above that which is necessary to the formation of the quantity "of carbonic acid gas which is produced "as had been supposed, but that the "one is equivalent to the other." The accuracy of these experiments no one has doubted and many chemists of great respectability have admitted that they completely subvert the theory of the oxygenation of the blood. Mr Murray, whose opinion is certainly deserving attention, when speaking of the theory of Crawford which supposed that carbon and hydrogen were united to the blood while circulating

through the body and that which maintained that oxygen was absorbed or exists in a state of loose combination in arterial blood, remarks that, "an objection to both hypotheses, not less important is, that the changes which they suppose are not analogous to the chemical changes, which take place in the animal system; and that they are not sufficiently connected with the purposes which the blood serves in its circulation." — — — — —

Analogy will furnish some support to the theory of the decarbonization of the blood, for by carefully attending to the changes that vegetables produce in the air, there can be no doubt but that the same process goes on in them as in animals. It may be said that analogical facts or reasoning however apposite, would have but little weight - true - they are by no means advanced as direct proof; but as a species of collateral evidence they are of importance as they aid that which is more positive. — — It appears by a variety of experiments, that oxygen gas is essential to every period of vegetation. During germination it must be supplied; if it is abstracted the process ceases; when it is present

carbonic acid gas is invariably formed and the volume of air in the vessel is not diminished - hence the seed absorbs no oxygen. Mr Ellis, whose experiments upon this subject are the latest and by far the most decisive has shewn that growing vegetables require oxygen and that carbonic acid gas is formed sufficient to account for all the oxygen consumed. It is only from such a view of the subject, that we can offer any satisfactory explanation of several phenomena connected with vegetation. There are, for example, some plants that will continue to grow at a temperature below 32° of Fahrenheit's Thermometer or in other words they will continue to perform all the functions of a living vegetable - if one of these is surrounded by snow, it will ~~continue~~ melt that portion that is nearest to it. This fact is familiar to every one. The explanation of it is perfectly simple. The living plant discharges carbon which unites with the oxygen of the air forming carbonic acid gas - and as this gas has a less capacity for caloric than oxygen - a quantity of this subtle fluid is extricated, sufficient to produce the effect

note
be exp
pature
rouge
and
dead
per
will
Pari
Jum
vinin
Mate
If m
the s
notic
fact
There
have
be a
tio. O
or ci
in ha
ng to
in th
ca b
stan
ex
diffe
gase

tated. – If equal quantities of water
exposed in similar vessels, to a tempe-
rature sufficiently low partially to
congeal the fluid and if in the one
be place branches of living vegetable
and in the other the same quantity of
dead wood, – crystals of ice will be
seen in the latter while no congelation
will take place in the other. This ex
periment was performed by Mr J
Hunter, and has been repeated, with
similar results, by the Professor of
Materia Medica in this University.
It may be explained precisely in
the same way as the last. – I shall
notice only one other analogical
fact. In the large end of the egg,
there is a quantity of air: experiments
have shewn, that this is oxygen gas.
In applying the tongue to this por-
tion of the egg – so long as it is sound
or alive, a degree of warmth will be
imparted to it: – this can only be owi
ng to the gradual conversion of oxygen
in this portion of the egg and the
carbon thrown out from the sub-
stance of it, into carbonic acid gas,
and the warmth is owing to the
different capacities of the two
gases for caloric.

After this process of decarbonization goes
not only in the ova of animals, but in
the germination and growth of vegetables,
it explains not only animal respira-
tion, but several phenomena connected
with it inexplicable by the other
hypothesis and if above all it is
supported by direct experiment.
conclusive and accurate, why should
we for a moment withhold our assent
from it? or why should we not rather
endeavour to point out its superior-
ity over the theory of the oxygenation
of the blood, as it is more simple,
intelligible and consistent with
the laws of the healthy body? - -

By considering a few facts connec-
ted with respiration and attempting
to explain them. I shall conclude these
remarks. According to the experiments
of Seguin and Lavoisier it appeared
that less oxygen was consumed in a
high temperature than a low one - the
explanation of this fact is by no
means difficult. By the experiments
mentioned by Mr. Ellis, it was as-
certained that the skin discharge
carbon and not carbonic acid gas as
has been supposed; in a high tempera-
ture, this discharge would be increased
in consequence of the increase of

perspiration and of course the skin even
perform in part a vicarious office
for the lungs, assisting them to discharge
the surplus quantity of carbon from the
blood. -- May we not suppose that
the purple colour of the skin which we
observe upon a partial application of
cold to the body, arises merely from
this - that the vicarious office of the
skin is suspended by the abstraction
of caloric, that a quantity of carbon
is thrown upon the lungs greater
than they are able to discharge and
of course that the blood is only par-
tially freed from that principle
which gives the dark black colour
to that fluid in the pulmonary
arteries? - - - - - In all chronic af-
fections of the lungs, cold is highly
deleterious. Hence the Professor of the
Institutes of Medicine has recom-
mended that during the winter
season phthisical patients should
be kept in a temperature uniformly
mild. The high and respected author-
ity from which this advice comes
would leave me no reason to doubt of
its excellence, even if I were unable
to divine the reason or object of it. But this is
not the case - and it may be shewn

be correct in the following way. In most persons the lungs are debilitated and diseased - even the performance of their usual office is attended with pain and by increasing their duty (by exposing the body to cold) we only add to the complaint. By suffering the skin to perform its vicarious office we prevent the danger that would arise from crowding the lungs with blood charged with carbon which they would be unable to throw off and death would no doubt in very many instances be the consequence. - - - - - From a moments attention to the subject it must be evident, that many other physiological and pathological inferences of more importance might be drawn from this theory - but as many think it far from being perfectly established, I shall proceed no farther. - I am aware that in offering objections to the theory of the oxygenation of the blood, I am opposing the opinions of a very large majority of the physiologists of the present day. But the prevailing opinion is by no means always the correct

ne-; it is not very many years
since the mechanical theory of di-
gestion was very popular and if man-
kind had feared to attack it from
the number of its supporters; we
should have had at the present
day an hypothesis which maintained
that bones were digested by the mas-
ticatory power of the stomach. Though
it was unable to explain how many
soft substances passed through
that organ without being acted
upon. I am far from intimating that
the theory of the oxygenation of the
blood is as grossly absurd and ridicu-
lous as the one I have stated - on the
other hand I think that it has much
plausibility and discovers no small
degree of acuteness and judgement.
It is by no means wonderful that
it should have been so generally
adopted, after its first promulgation,
it served to add to the importance of
oxygen gas which had just been dis-
covered and which a large portion
of mankind were disposed to think
was the sine qua non, without which
scarcely any process could proceed.
This theory made it the great stimulus
that supported life and maintained

that as it circulated through the body with the blood it stimulated every part of the system into action. Dr Girtanner and some others advocated the opinion that oxygen was the acid principle and supported their opinions with a number of experiments. In fine, there is been no station assigned for oxygen, as it is related to the animal body; but it may be questioned whether the introduction of pneumatic Chemistry into physiological science will be productive of those immensely important consequences which its supporters have always supposed.

The examination of the subject that has been made at the present time is deficient no doubt in many very important points; if it were proper to apologize. The author would observe that it was written in great haste, in a space of time unexpectedly short and amid a variety of avocations that could not be dispensed with. Certain he is,

that
any
for
fa
his o
from
some
duc
one
was
infor
Pat
perfe
this
rega

at if he has not brought forward
y important objections to the
ol theory or any strong argument
favorable of the new — it is from
is own want of powers and not
rom the barrenness of the subject.
ome points might have been
ucidated by experiments and
ome positions confirmed — and it
as originally intended to have
erformed these — but those causes
hat produced the numerous im-
erfections in the other parts of
his thesis, operated equally with
egard to this. — — —

Finis.